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## **CHAPTER 1**

# **Summary and Findings**

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# Summary and Findings

## INTRODUCTION

During the 1970's, the Middle East was the world fastest growing market for engineering products, construction, and technical services. Rising oil revenues supplied the oil-producing nations in particular with the financial resources needed to purchase these imports. At no other time in recent history has a group of developing nations attempted so quickly and dramatically to transform their economies and societies as did the Islamic nations of the Middle East during this period. The experiences of these nations, which have been in a unique position to import advanced technologies from abroad, elucidate the promise and problems of technology transfer to developing nations.

U. S. firms and organizations have been major suppliers of engineering products and technical services to the Middle East, and this raises important issues for U.S. policy. These include questions concerning the competitive positions of U.S. firms in developing country markets, the long-term effects of technology transfers on the growth of export industries abroad, the effectiveness of U.S. Government-supported assistance programs involving technology transfers, and the military-strategic implications of advanced civilian transfers. The U.S. Government has no coherent policy governing technology transfer to developing nations, and there has been no systematic study of the policy implications of civilian technology transfer to the Middle East. The Office of Technology Assessment (OTA) research was designed to clarify U.S. policy issues germane to civilian technology transfers to Islamic countries in the Middle East. \*

\*The research focuses on six Middle Eastern nations: Algeria, Egypt, Iran, Iraq, Kuwait, and Saudi Arabia. These countries were selected because they have imported comparatively large volumes of equipment and technical services, because they have varied financial resources and labor forces to support technology transfer, and because they have different approaches to foreign policy and industrial development. Because Israel has

Recipient and supplier nations alike have critical interests at stake in technology transfer. As a process that enhances the recipient's capacity to produce goods and services, technology transfer is a two-way interaction. For developing countries, successful technology transfers promise economic growth, improved living conditions, manpower development, and even enhanced national prestige and influence. However, technology transfers that fail or have unintended consequences may pose economic and political problems. From the perspective of supplier nations, technology transfers may help win friends, cement political alliances, increase exports, or alternatively lead to resentment and conflicts of interest. The promises of success and problems of failure are particularly apparent when new and complex technologies are introduced into developing nations that have limited scientific and technological infrastructures.

This study, undertaken at the request of the House Committee on Science and Technology and the Senate Committee on Banking, Housing, and Urban Affairs, examines the process of technology transfer to the Middle East (focusing particularly on competition among suppliers and absorption of technology by recipients) in order to identify policy issues for the United States. The Subcommittee on Energy, Nuclear Nonproliferation, and Governmental Processes of the Senate Committee on Governmental Affairs presented a supporting request that the study deal with transfers of nuclear technology to the Middle East.

attained a much higher level of technological development, it is not included as a major focus of study.

The term "Islamic countries" is used here simply to indicate that sizable proportions of the populations of these and some other Middle Eastern countries are Muslims, or followers of Islam. As discussed in ch. 3, however, there are many groups in these countries and the role of Islam in politics, economics, and social affairs varies widely.

The study examines technology transfers required for the establishment of several complex civilian production and service systems: petrochemical and nuclear power production facilities, telecommunications systems, commercial airline support services, and medical services. These types of technology transfers were selected because they are associated with large volumes of trade in equipment and technical services, because of the challenges recipients face in fully utilizing them, and because in recent years U.S. policies have restricted exports of advanced technologies for political and military reasons. This study addresses the following questions concerning advanced technology transfers:

- How extensive have transfers of advanced technologies been to the Middle East during the last decade, and what factors affect international technology trade?
- What factors inhibit or enhance the ability of recipients to utilize or absorb ad-

vanced technologies, and do the experiences of various nations differ?

- How effectively have U.S. firms and organizations transferred technology, and how well have they competed with those organizations from other supplier nations?
- What are the prospects for technology trade with the-Middle East during the next decade, and what policy options are available to the United States?

Many U.S. policies affect technology transfer to developing nations in the Middle East, although these policies were not formulated with that goal. Technology transfer is often an underlying issue in discussions of development assistance, commercial, and political-strategic policies. Public policy debates, however, rarely center on civilian technology transfer. This study addresses the issue of whether the United States should develop more consistent policies regarding technology transfer.

## PRINCIPAL FINDINGS

### TECHNOLOGY TRANSFER AND TRADE DURING THE PAST DECADE

During the past decade, Middle Eastern countries have rapidly expanded their imports of advanced civilian equipment and technologies. The major suppliers have been the United States, Japan, and the West European countries. Total exports from industrial countries to 15 Islamic countries in the Middle East rose from \$5.5 billion in 1970 to about \$100 billion in 1982, an eightfold increase in constant dollars. Engineering products—machinery, equipment, and instruments—accounted for about half of these exports. Technical and managerial services have been increasingly important exports.

The Middle East is a very competitive marketplace, and suppliers have specialized in exports of certain types. U.S. firms have been major suppliers of machinery and equipment, particularly nonelectrical machinery and air-

craft. Like the United States, West Germany and Japan have been major suppliers of machinery and equipment, but Japanese firms have been prominent in exports of basic manufactures such as consumer electronics and dominate in exports of road vehicles. In contrast, French firms have been particularly prominent in public works projects. U.S. firms appear to have had a comparative advantage in the technical services area, including management of large projects and provision of technical support. For newly industrializing countries such as South Korea, the Middle East is a key market for construction services. Soviet bloc countries have been much less prominent in commercial technology trade, but some of them have expanded sales in certain market niches such as medical services.

In 1982, the market share of U.S. firms remained approximately the same as it had been in 1970, 20 percent of machinery and equipment imports to the Middle East (see fig. 1). In con-

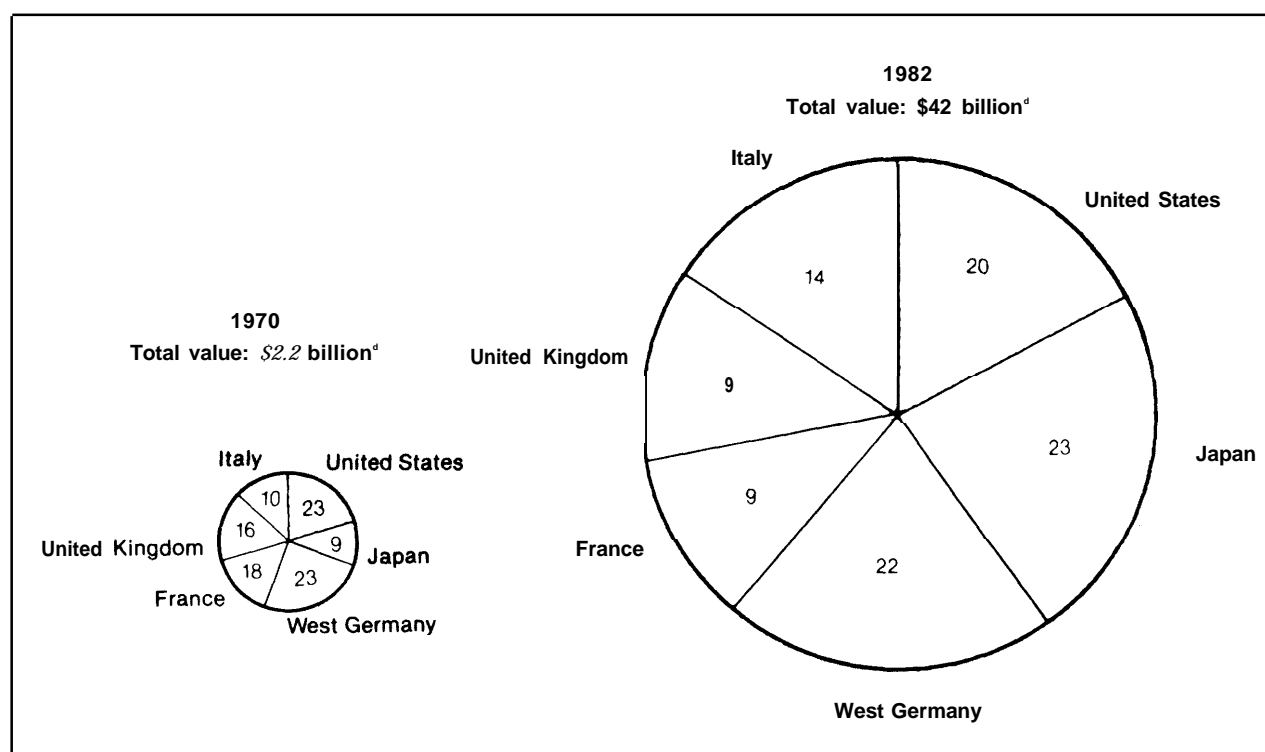
trast, Japanese firms increased their market share during the same period from 9 to 23 percent, while France's market share fell from 18 to 9 percent. U.S. economic interactions with the region have, furthermore, been strongly concentrated in trade with a small number of nations. Exports to Saudi Arabia and Egypt accounted for more than two-thirds of U.S. exports to the region in 1982.

Although Middle East technology trade has increased rapidly, OTA's research indicates that technology transfers have been limited. For the purpose of this study, technology transfer is a process involving a supplier and recipient whereby the recipient attains, as a result, an improved capability to operate an industrial production facility or service system. Technol-

ogy trade, which includes international sales of industrial rights, equipment, technical services and training, and plans and documents, is only one part of technology transfer. Technology utilization or absorption by the recipient is a critical part of technology transfer. The extent of absorption depends on the type of capability developed by indigenous personnel in a particular firm or industrial sector—to operate and maintain equipment or, at higher levels, to modify the technology or design and produce new products. OTA's research shows that technology is much more easily traded internationally than it is absorbed by recipients in developing countries.

In the Middle East a number of factors constrain technology absorption. They all relate to the considerable technological distance that

Figure 1.—Supplier Shares of Six Industrial Countries in Machinery and Equipment Exports<sup>a</sup> to the Middle East,<sup>c</sup> 1970 and 1982 (percent)



<sup>a</sup>Includes exports from the United States, Japan, West Germany, France, United Kingdom, and Italy.

<sup>b</sup>HSITC commodity code 7.

<sup>c</sup>Includes imports to the following Middle East countries: Saudi Arabia, Iran, Algeria, Egypt, Iraq, Kuwait, United Arab Emirates, Syria, Lebanon, Jordan, Qatar, Oman, Yemen, South Yemen.

<sup>d</sup>In current dollars.

SOURCE: Office of Technology Assessment (based on table 28), and United Nations, *Trade With Industrial Countries*, Supplement to World Trade Annual.

must be bridged between the suppliers and the recipients. Chief among them is a disparity between human and financial resources. Countries such as Saudi Arabia and Kuwait, despite their capital resources, are constrained by shortages of technical and managerial personnel. In contrast, Egypt is the Middle Eastern country with the most extensive technological infrastructure, but many Egyptian engineers and teachers have gone abroad to find work. In addition, the Islamic countries of the Middle East are challenged to use foreign technologies and personnel in meeting development goals without creating irreconcilable conflicts with traditions and among groups in their societies.

### **TECHNOLOGY TRANSFER: COMPETITION AMONG SUPPLIERS AND TECHNOLOGY ABSORPTION**

OTA's analysis of competition among suppliers for sales of advanced technologies indicates that a broad array of factors has influenced contract awards. In addition to price, the willingness of firms to provide state-of-the-art technologies, after-the-sale service, and training, as well as marketing strategies have been particularly important. While they have not determined overall patterns of technology trade, supplier government policies involving export financing, export controls, and representation of business have also been important factors in some cases.

To assess the extent of technology absorption, OTA's research focused on the technology-using firms and industrial sectors. The experiences of suppliers and recipients in various types of technology transfers were found to differ widely.

#### **Petrochemical Production**

Middle Eastern countries such as Saudi Arabia are currently expanding their petrochemical production facilities so that by the 1990's they will be producing approximately 4 percent of all major commodity petrochemicals manufactured worldwide, and their ex-

ports in these products will account for 20 percent of worldwide trade. Petrochemical technology transfers contribute to the growth of an important Middle Eastern export industry.

Middle Eastern countries building petrochemical industries (Saudi Arabia, Kuwait, Qatar, Algeria, Bahrain) have financed these capital-intensive projects themselves. However, they remain dependent on foreign technical assistance, even though the technology has become fairly standardized. U.S. firms are currently playing major roles as joint venture partners, licensors of technology, and contractors—particularly in Saudi Arabia, where joint ventures have been promoted. The quality of technology offered has been a major consideration for Middle Eastern countries in their awards of contracts to foreign firms. Kuwait, alone, has attempted to obtain petrochemical technology extensively through purchases of equity ownership in foreign firms.

Petrochemical technology is transferred to Middle Eastern countries in packages. This type of technology transfer allows recipients to operate the facilities efficiently by relying extensively on expatriate managers and technicians. Over the long run, maintenance of the facilities and development of a skilled manpower base will be key issues for Middle Eastern petrochemical firms. Nevertheless, Middle Eastern nations will become world-scale producers in the 1990's. Certain aspects of petrochemical production, such as comparatively low manpower requirements, capital intensity, and feedstock requirements, make it particularly well-suited to development in the countries bordering the Persian Gulf.

During the late 1980's, additions to petrochemical production capacity in the Middle East, Canada, Mexico, and Southeast Asia will have significant effects on global petrochemical product trade. Firms in western Canada and Mexico are more likely to make significant inroads in U.S. petrochemical markets than Middle Eastern manufacturers. While the United States will probably become a net importer of ethylene glycol and methanol by 1990, the U.S. petrochemical industry can remain strong, if production of specialty (and sec-

end-tier) chemicals becomes relatively more important. The impacts of these changes on employment in the United States should be minimal, since U.S. firms will continue to supply a large domestic market.

Petrochemical technology transfers to the Middle East therefore portend problems of structural adjustment for the industrialized countries, which will be particularly acute for Japan and Western Europe. It is unlikely that even a decline in the price of crude oil to as low as \$25 per barrel would have a significant effect on the growth of the Middle Eastern petrochemical industry. A major problem involves the possible growth of protectionist barriers in Western Europe, which could be stimulated if Middle Eastern manufacturers sharply reduce prices to gain market shares. If U.S. manufacturers emphasize production of specialty and second-tier chemicals, improve efficiency of operations and invest in research and development (R&D), they should be in a position to adjust to these anticipated changes in world markets.

### Telecommunications Systems

Telecommunications systems are important components of the national infrastructure needed for the growth of other industries and services. Technology absorption has been enhanced by the high priority placed on the development of this sector by Middle Eastern governments, by rapidly growing demand for services, by opportunities for regional cooperation, and by local production of equipment in Algeria and Egypt. On the other hand, inconsistent policies, shortages of indigenous technical workers in Saudi Arabia and Kuwait, and, in Egypt, inadequate incentives for technical personnel working primarily in government-owned telecommunications networks have limited absorption.

Competition among suppliers has been intense. Japanese firms have gained market share in telecommunications exports. Exports from the United States have been primarily in advanced technology subsectors, such as satellite communications, and they have been

strongly concentrated in Saudi Arabia and prerevolutionary Iran. Since the major suppliers are now on a technological par in telecommunications, other factors have influenced contract awards. These include the ability of suppliers to provide comprehensive financing, as well as their reputation as reliable suppliers, their commitment to after-the-sale support, and the involvement of a firm at an early stage of a project when initial equipment selections are made. Although U.S. firms maintain a reputation for technical capability, the ability of firms from Western Europe and Japan to put together comprehensive financing packages, sometimes including associated business deals, has been an advantage for them in some instances. U.S. Government financing, however, has supported telecommunications technology transfers to Egypt and Algeria.

### Commercial Aircraft Support Services

Compared to other types of technology transfers examined by OTA, the most extensive technology absorption has been in the area of commercial aircraft support services. The operating statistics of these airlines (including safety) indicate that they are on a par with major international airlines. The comparative success of recipients in using these technologies can be ascribed to a number of factors, including well-defined standards of training and performance and relatively long experience. Nevertheless, some of these airlines will depend on foreign technicians (for engine maintenance) for the foreseeable future. This is not because of a lack of ability on the part of indigenous workers, but rather due to a shortage of local technical workers willing to perform these tasks in Saudi Arabia and Kuwait.

U.S. firms are acknowledged leaders in avionics and aircraft engines, and have been leaders in airport management, but other suppliers are increasingly capable of providing similar equipment. U.S. aircraft sales in the region, important to sales of auxiliary equipment and services, have been negatively affected by U.S. export controls. Middle Eastern governments have in some cases sought to diversify sup-

pliers for political reasons, such as dissatisfaction with U.S. policy positions.

### Medical Services

During the last 10 years, Middle Eastern governments have strongly emphasized health care by increasing budgetary allocations to that sector. Of all the technology transfers examined by OTA, those in medical services are most likely to affect directly the longevity and quality of life of the average citizen in the Middle East. In addition, U.S. policymakers have a special interest in technology transfers in medical services—not only because medical equipment and services are important exports, but also because health care has been a priority in U.S. assistance programs.

Saudi Arabia is the largest Middle Eastern market for medical equipment and hospital management services. U.S. firms produce high-quality and reliable equipment, and they provided 18 percent of the medical equipment imported by Middle Eastern nations in 1980. U.S. firms have also been particularly prominent in the field of hospital management, providing evidence of their strong role in curative medicine. However, U.S. firms are not known for after-the-sale service. OTA's research indicates that such service has become a critical consideration for Middle Eastern buyers of medical equipment.

In contrast, U.S. assistance programs carried out by the Agency for International Development (AID) have focused on preventive health care, particularly in rural areas of lower-income countries, such as Egypt. Other supplier countries such as Sweden, Japan, Taiwan, and Belgium have aggressively promoted exports through bilateral health care agreements.

A major obstacle to medical technology transfer to the Middle East has been a lack of appropriately trained local medical personnel and experienced managers. Kuwait and Saudi Arabia possess the most sophisticated medical facilities, but their indigenous technical manpower bases are much more limited than those of Egypt and Algeria. Despite the commitment of Kuwait and Saudi Arabia to training and

employing indigenous populations, cultural and other factors have inhibited recruitment of nationals into medical services. Foreign expatriates will be required to staff their medical facilities well into the 21st century. On the other hand, Egypt—a nation that exports medical personnel to other Arab nations—is challenged to improve the quality of personnel and management and integration of Egypt's varied health care facilities, public and private.

In the past decade, U.S. firms have been independently involved primarily in large hospital development projects in the region. In the future, the most pressing need will continue to be in the area of preventive and less-sophisticated health care. While opportunities for hospital management will continue in Saudi Arabia, demand for these services may grow less rapidly. Recipients will attempt to establish joint ventures with foreign suppliers in order to obtain specialized services such as training of indigenous personnel. The market share of U.S. firms in medical equipment may shrink unless improvements are made in U.S. after-the-sale service and maintenance. AID health projects have generally contributed to improvements in Egyptian health indicators, but programs providing specialized training and retraining of medical personnel may be particularly important in the future.

### Nuclear Power Generation

Nuclear power is in its infancy in the Islamic countries of the Middle East: there is no commercial nuclear power reactor in operation in the region today nor is there likely to be one in operation before the 1990's. However, decisions made now concerning nuclear technology transfers may significantly affect the economic, military, and political future of the region. Middle Eastern approaches to nuclear technology transfers differ widely: Iran had the most ambitious commercial nuclear power program prior to the revolution; Egypt has the strongest rationale for commercial nuclear power, but financing remains a major constraint; Libya has most clearly expressed its intentions to develop nuclear weapons. Most



of the nations of the region have not yet committed themselves to nuclear programs.

Despite the very high growth in demand for electricity, a number of factors reduce the attractiveness of commercial nuclear power for most Middle Eastern countries. The most important is the availability of hydrocarbon resources. In addition, only Egypt, Iran, Kuwait, and Saudi Arabia will possess the interconnected grid and electricity generation capacity needed to accommodate a 900-megawatt (MW) commercial reactor by 1990.\* However, if small reactors (under 600 MW capacity) become available, other Middle Eastern nations could be buyers. OTA's analysis indicates that nuclear desalination, a potentially useful application, will be attractive only to nations where nuclear power generation is economically feasible. Even for Egypt, the country with the strongest rationale for nuclear power, progress in nuclear power development has been slow. Egypt's program will progress only with subsidized financing from abroad.

Transfers of nuclear technology are important not only because of their potential in electricity generation, but also because transfers of certain types raise questions of nuclear weapons proliferation. OTA's analysis indicates that no Islamic Middle Eastern country will be capable of acquiring a nuclear device on a wholly indigenous basis within this decade, and most would find it impossible to do so before the turn of the century. The major constraints on the proliferation of nuclear weapons have been the weak technical capabilities of these countries and the reluctance of suppliers to sell unsafeguarded enrichment and reprocessing facilities.

The most likely path to nuclear weapons production is through the use of small-scale research reactors in conjunction with laboratory-scale enrichment or reprocessing facilities over a long period of time, allowing for production of very small amounts of weapons-grade materials. Middle Eastern countries will build their

latent nuclear weapons production capabilities gradually, unless one of the countries in the region demonstrates its capability to produce nuclear weapons and thereby stimulates other nations to follow suit, or unless supplier nations significantly relax export regulations and safeguards requirements.

Prospects for nuclear weapons proliferation in the Middle East are likely to increase during the next decade because new supplier states, such as Argentina, Brazil, and India, that are not parties to the Nonproliferation Treaty may be willing to sell sensitive facilities and also because Middle Eastern countries will gradually improve their indigenous capabilities. Policy options available to the United States are limited, but they include bilateral nuclear cooperation agreements with countries developing expanded nuclear power for peaceful purposes, financing of nuclear exports to countries accepting stringent safeguards, or assistance to developing nations in assessing various energy options. Stronger consensus among suppliers to limit exports of highly enriched uranium and laboratory-scale sensitive facilities could contribute significantly to nonproliferation goals.

### Impacts of Technology Transfer to the Middle East

The ability of recipient countries to utilize imported technologies effectively depends not only on the sophistication of the equipment, but also on the capabilities of the indigenous work force. OTA research indicates that experiences with technology absorption differ widely across countries and technology sectors. Generally speaking, recipients have developed an independent capability to operate and maintain facilities, but not to modify equipment or significantly adapt technologies imported from abroad.

Not surprisingly, technology absorption has been most limited when new and extremely complex technologies were introduced. Transfer of nuclear technology represents the extreme case—not only is experience limited and technologies complex, but most of these countries have not built an internal consensus fa-

\*These countries will probably be able to install a 900-MW reactor that does not generate more than 10 percent of total installed interconnected electrical grid.

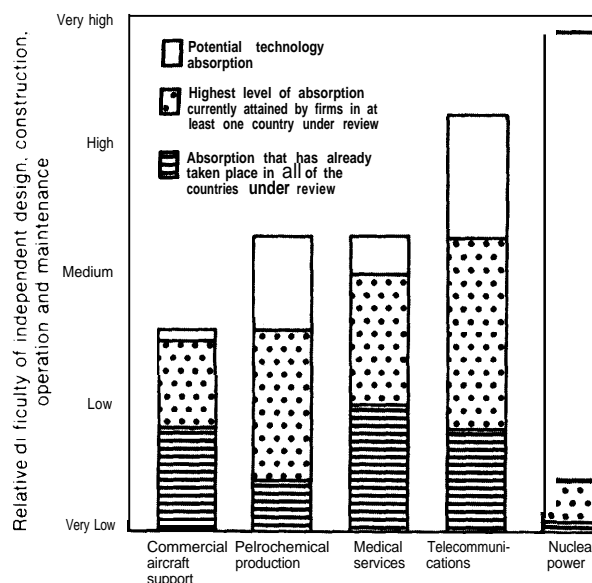
voring nuclear power development. Technology absorption has been comparatively extensive when transfers contribute directly to production of locally used goods and services, as indicated by successful transfer of commercial airline support technologies. In cases where industries are not forced to compete directly with foreign firms, recipients have more leeway to introduce training and local employment requirements, though this is often costly.

In contrast, technology absorption in the petrochemical sector will be limited for some years to come, mostly because this industry must compete directly with industry leaders in world markets. Middle Eastern petrochemical producers are relying heavily on expatriate personnel and the acquisition of technology in the form of packages, while gradually increasing indigenous personnel. Technology transfers in petrochemicals will benefit recipients through increased export revenues, despite the near-term limitation of technology absorption. Figure 2 illustrates a range of experiences with technology absorption in the five sectors under study.

Middle East countries face varied problems in importing and using foreign technologies. A key question is how quickly to implement programs aimed at expanding the indigenous technical work force. Rapid expansion can be very costly in the short run. However, reliance on expatriate labor may limit long-term absorption, particularly if it precludes development of domestic technological capability. For both the oil-rich and oil-poor countries, inadequate supplies of technical manpower present a critical constraint on technology absorption. Egypt's problem is to put to better use and upgrade the capabilities of its comparatively well-developed technical manpower base; Saudi Arabia and Kuwait must build from much smaller technical manpower bases.

The technology transfers examined by OTA have certainly contributed to the growth of Middle Eastern economies and to the export revenues of supplier firms. From a commercial perspective these technology transfers have generally been mutually beneficial. For each type of technology transfer, OTA identified positive and negative effects (political, social, economic)

Figure 2.—Summary of Findings: Technology Absorption in the Middle East, 1984



Note: Height of bar indicates relative difficulty of tasks required to design, construct, operate and maintain facilities independently. *Potential technology absorption* refers to the level required to operate and maintain facilities independently on a par with similar facilities in industrial countries. Evaluation of the current extent of technology absorption is based on an assessment of the sophistication of technologies and the efficiency of operations as well as the capability of indigenous personnel to use them.

SOURCE: Office of Technology Assessment

on recipients and suppliers. The choices made by political and technical leaders in the recipient countries about selection and use of imported technologies lead to fundamental economic, social and political changes in their countries. In some cases, certain groups in society may benefit disproportionately from advanced technology transfers, leading to resentment and political opposition on the part of others. In other cases, the life of the average citizen may be greatly improved. Choices made by policy makers determine whether the technology transfers fit with resource endowments, meet the needs of the local population, or build indigenous capabilities.

Technology transfers involve ongoing relationships between recipients and suppliers that include both potential risks and benefits. It is beyond the capacity of governments to develop policies that eliminate these risks or anticipate the potential effects of all commercial technology transfers.

## POLICIES AFFECTING TECHNOLOGY TRANSFER

No nation has developed a systematic policy governing international technology transfer, but many recipient and supplier nations have developed policies to promote and regulate technology transfer.

### RECIPIENT COUNTRY POLICIES

Policymakers in the Middle East are trying to transform their economies rapidly, largely through the introduction of foreign technologies. Yet they are attempting to do so while avoiding excessive dependence on foreign suppliers; maintaining their political legitimacy and influence over domestic economic, social, and political developments; and preserving indigenous cultures, traditions, and values. Despite these common challenges, there is considerable variation in the policies of these countries.

These countries do not have comprehensive technology transfer policies, but all are attempting to improve their capacities for selecting and using foreign technologies, carried out primarily by strong government firms and institutions. Each has developed an implicit strategy for dealing with technology transfer choices in conjunction with development planning, and some have already experimented with and modified their approaches in the last decade. All face choices concerning the nature and pace of economic development, promotion of private enterprise, regulation of foreign businesses, choice of suppliers, financing, education and manpower policies, and administrative reform.

Saudi Arabia and Kuwait emphasize capital-intensive technology transfers, while Algerian leaders, dissatisfied with the earlier emphasis on heavy industrialization, have come to stress labor-intensive technology transfers. While Iraq has attempted to limit involvement by foreigners, Egypt and Saudi Arabia have encouraged joint ventures.

These countries face different immediate problems. For the labor-short Gulf States, Saudi Arabia and Kuwait, one challenge is to train indigenous workers to use foreign technologies effectively. In both countries, shortages of technical manpower may be allayed over the short term through a reliance on foreign labor while the local population is gradually trained. However, technology absorption may be limited in the long term unless the local population is attracted to enter technical jobs by incentives introduced by the governments.

For those countries with larger populations but limited financial resources, such as Egypt and Algeria, issues of promoting private sector firms, administrative reform and the financing of technology transfer are paramount. Egypt, a country rich in human resources, is challenged to eliminate the economic disincentives such as subsidies and occupational redundancy that grew with a large bureaucracy and to introduce efficiency into public sector firms. Egyptian leaders must chart a delicate course, however, because economic reforms may give rise to conflicts among various groups. Algeria as well as Egypt must deal with the issues of administrative reform and migration of workers abroad.

Both Iran and Iraq had comparatively well-developed infrastructural and industrial bases prior to the current Iran-Iraq War. A key issue for both is how to compensate for the diminution in resources available for civilian technology transfers resulting from their preoccupation with the war effort. In Iraq, lack of financing has already jeopardized technology transfer plans in certain sectors. The regime in Iran, though outwardly hostile to Western influences, has in recent years expanded trade with West European and Japanese suppliers. For both these countries, however, the war is the key factor affecting prospects for civilian technology transfer.

These countries have attempted to diversify their reliance on outside suppliers of technology for both political and economic reasons. Most of them also look favorably on proposals for regional economic and technical cooperation, though progress has been limited by political differences. The persistence of regional conflicts undoubtedly remains a major constraint on effective commercial technology transfer.

#### POLICIES OF OTHER SUPPLIER COUNTRIES

Apart from the United States, the most important countries supplying advanced technologies to the Middle East are those in Western Europe, and Japan. In comparison to the United States, Japan and West European countries emphasize economic interests more in their foreign policies, and their policies have generally supported technology trade with the Middle East. While these nations have approached technology transfer quite differently, the absence of controls on technology exports—as well as their readiness to combine development assistance and commercial promotion programs and the willingness of government officials to take a leading role in economic diplomacy—have supported expanded technology trade with the region. Supplier-government export financing has influenced competition in transfers of commercial aircraft, telecommunications, and nuclear power technologies, to countries such as Egypt and Algeria, but official export programs have not determined general patterns of technology trade. More importantly, government and business are normally on the same side—supporting technology trade.

Soviet bloc nations, in contrast, are much less important as suppliers of advanced civilian technology to the Middle East, and therefore do not figure prominently as competitors in the technology transfer sectors examined by OTA. For the Soviet Union, military assistance has been the most important channel for interactions with Middle Eastern countries, but commercial interests have become more

salient in recent years. Some East European countries have expanded exports to the Middle East, but they provide only a small share of total imports to the region, and these have been concentrated in a few sectors such as heavy machinery. Despite the comparatively small role that Soviet bloc nations play in commercial technology trade with the region, some Middle Eastern countries have been recipients of Soviet military assistance, and the Middle East has been the largest noncommunist developing country export market for Soviet bloc nations.

Supplier governments play important roles by setting the context for technology trade through their foreign policies. Historical and political factors strongly influence technology trade with Middle Eastern countries. French exports flow primarily to Egypt and Algeria (a former colony), while British exports go to Oman, the United Arab Emirates (UAE), and Qatar—all under British rule in years past. Soviet bloc exports are concentrated in Iraq, Iran, Syria, and Algeria. In contrast, Japan's technology exports are less concentrated and reflect that country's weak historical ties to particular nations in the region.

The United Kingdom and the Soviet Union, which in addition to the United States have played important political and diplomatic roles in the Middle East, have placed less stress on promotion of commercial technology trade than have nations such as Japan, West Germany, Hungary, and Romania. France, in contrast, has attempted to combine a high-profile diplomatic role with state-led trade promotion. In the past decade, Japan, a nation that has not assumed a leading political role in the Middle East, expanded its market presence in countries with differing positions on political issues. Government policies, particularly overall foreign policies concerning the Arab-Israeli dispute, remain important influences on technology trade. In some cases, the absence of political constraints on trade set by supplier governments has been an asset to foreign exporters in establishing diverse trading relations in the Middle East.

## U.S. POLICIES

U.S. policies affecting technology transfer have been more restrictive than those of other Western supplier nations. During the past decade, U.S. trade with countries of the Islamic Middle East has grown rapidly, despite the fact that official policies have been characterized by an unusual tension between economic and political goals. This tension has precluded the formulation of a coherent policy governing technology transfer.

U.S. interactions are strongly concentrated in a few Middle Eastern countries: in commercial trade, Saudi Arabia and Egypt are the major trading partners of the United States; in economic and military assistance Egypt (and Israel) have been the most important Middle East recipients. U.S. technology trade with the Middle East thus reflects political alliances.

During the last 30 years, U.S. foreign policy has reflected four themes: ensuring the security of Israel, ensuring oil supplies to the West, limiting Soviet expansion in the region, and promoting the economic and social development of Middle Eastern countries. Official U.S. policies have, however, placed increasing stress on military and security issues rather than on commercial interests during the past 10 years.

U.S. Government programs designed to promote the representation of U.S. business abroad, including both high-level trade missions and routine representation by the Foreign Commercial Service, have been comparatively weak. Only a few programs are designed, even in part, to promote technology transfer. In addition, there has been continuing controversy concerning official export financing, particularly mixed credits, which combine commercial and confessional financing. U.S. export financing programs are not as broad in scope as those offered by some other Western supplier nations. On the other hand, such Government supports have only infrequently been determining factors in competition for contracts in Middle Eastern markets. Finally, the United States has established few bilateral trade or

investment treaties with any nations in the region except Egypt.

U.S. development assistance policies are particularly important for lower-income Middle Eastern countries, especially Egypt. AID administers a vast number of programs, but few are designed with the goal of promoting technology transfer in the industrial and service sectors examined by OTA. Congress has emphasized the importance of science and technology programs, but in Egypt these programs have not been guided by a coherent strategy and only a small number are directed toward assisting industrial end-users of technology. The United States has few Government-supported technical assistance efforts in high-income, developing nations in the Middle East, the most prominent being those supported by the U. S.-Saudi Joint Commission.

U.S. policies affecting technology transfer are distinguished from those of other Western supplier nations by the recent expansion of controls on exports. These controls heighten the political dimension of U.S. technology trade with the Middle East. There is general agreement among U.S. experts that national security and nuclear nonproliferation controls have been effective in limiting exports of military equipment and slowing nuclear weapons proliferation. There is less agreement concerning foreign policy controls, antiboycott regulations, and other types of controls. Proponents of controls argue that the United States can use them to take a stand in support of political principles and that the economic loss resulting is minimal or worth the cost. Opponents argue that foreign policy and other "political" controls have rarely achieved their designated goals, that the economic effects have been significant, and that they earn the United States a reputation as an unreliable supplier. It is impossible to measure precisely the impacts of various types of controls on trade, but taken together these controls have been a liability to U.S. exporters and have served to inhibit trade. OTA research did not uncover cases where the use of foreign policy controls clearly resulted in the achievement of desired political results.

## FUTURE PROSPECTS

### PROSPECTS FOR U.S. TECHNOLOGY TRADE WITH THE MIDDLE EAST

For the Islamic countries of the Middle East, the decade ahead will be one of slower economic growth than the 1970's. The major reason is that oil revenues are expected to grow at a slower rate (5 percent per annum or less in real terms), reducing the prospects for government spending, which has been the major driving force behind technology trade. For this and other reasons, imports of machinery and equipment can be expected to grow at roughly the same rate as oil revenues, in contrast to the 19 percent annual real growth in the 1970-82 period. The Middle East will remain

an important market for technology trade in the years ahead, but the explosive growth of years past will probably not be repeated.

OTA's analysis includes two scenarios for the future, involving high and low U.S. export shares to the Middle East. While the high export share is theoretically possible, OTA concludes that it is less plausible. In light of anticipated slower growth in the volume of overall exports to the Islamic Middle East, it may well be that the U.S. export share will decline. A number of factors, including a shift toward smaller projects in the Middle East and the desire of Middle Eastern countries to diversify suppliers, and the course of the Iran-Iraq War will influence technology trade. U.S.



*Photo credit Aramco World Magazine*

In less than a decade backyard generators have been replaced by power grids, like the one shown here carrying electricity to the new Industrial city of Jubail in Saudi Arabia

firms, no longer enjoying an overwhelming technological edge over competitors in many sectors, must adjust to changing Middle East technology requirements in order to maintain their position.

## **OPTIONS FOR U.S. POLICIES AFFECTING TECHNOLOGY TRANSFER**

In view of the persisting tension among various policies (commercial, development assistance, military-strategic) affecting technology transfer, it is not surprising that a coherent technology transfer policy has not been established. Policy makers may wish to alter substantially the scope and nature of commercial technology transfers to the Middle East by developing a more consistent policy. In order to do so, however, a new understanding of the role of technology transfer in U.S. foreign policy would have to be established. Three general perspectives are outlined below.

### **Perspective 1: Selective Use of Technology to Promote Political Interests**

This approach would make technology trade the servant of U.S. foreign policy toward the Middle East. The U.S. Government would not only extend export controls to impose sanctions on countries whose policies run counter to those of the United States, but would also selectively provide advanced technologies (e.g., dual-use items) to countries associated with U.S. political positions. Development assistance programs could be used as a vehicle for rewarding friendly nations.

This option has the advantage of placing major emphasis on U.S. foreign policy interests that are of central importance to policymakers. It capitalizes on denial and supply of technology to influence the behavior of recipient countries. In cases where other policy measures are inappropriate or unavailable, this approach would allow for systematic policies of denial. On a more positive note, the provision of advanced technologies to nations

closely associated with U.S. positions could enhance their regional and global stature.

The approach, however, has serious drawbacks. Success would depend on accurate forecasts of the foreign policies of Middle Eastern countries. One danger would be that shifts in political alignments and regime changes could lead to sudden interruptions of technology transfers. Another problem is that if U.S. policy makers control items that are readily available from foreign suppliers, buyers probably will simply go elsewhere. This option would place considerable burden on the Government to monitor and regulate commercial trade and technology transfers, despite the fact that OTA's research indicates severe obstacles to anticipating the long-term effects of technology transfers.

In addition, this approach could be seriously impeded by disagreement concerning appropriate U.S. policies toward specific countries. Finally, it would rely strongly on the use of foreign policy controls, despite the fact that many observers question their effectiveness in achieving political goals. It would certainly politicize even more strongly U.S. technology trade and would run the risk of jeopardizing relations with nations not closely associated with U.S. positions, yet not strongly opposing them.

### **Perspective 2: Decouple Commercial Technology Trade From Political Interests**

Policymakers may wish to reduce the linkage between politics and economics which has distinguished U.S. policies from those of other supplier nations. This approach is based on the assumption that technology trade should be promoted with all nations, regardless of their political positions, because it not only brings commercial gains to the United States but also serves as a foundation for friendly political relations. U.S. diplomatic efforts would proceed independently, while trade in nonmilitary items would be permitted with any nation in the region where U.S. firms judged the mar-

ket opportunity worth the risk of investment or involvement. Foreign policy export controls would be eliminated, making U.S. policies more similar to those of Japan and West European countries.

One advantage would be to eliminate the tension that has existed between commercial and political interests; another would be to promote technology trade with Middle East countries. It would put U.S. firms on a more equal footing with their competitors, and possibly lead to the expansion of exports to nations not currently major U.S. trading partners in the region. In addition, it would place fewer demands on the Government to regulate trade than would the first option. This option could be expanded to include improved representation of business, but the major emphasis would be on decoupling trade from politics.

By eschewing the use of technology trade as a lever, this approach narrows the range of instruments available to policymakers. At the same time, it might increase the probability that U.S. firms could become targets of political opposition because of their expanded involvement in countries whose governments oppose U.S. political positions. Nor would such a policy guarantee the end of the selective technology trade characteristic of years past. OTA's research indicates that technology trade may remain strongly influenced by U.S. foreign policies: even if the disincentives for nonselective trade were eliminated and promotional policies enhanced, recipient governments might still wish to diversify suppliers for political reasons and U.S. firms might prefer to trade with countries friendly to the United States. However, ending foreign policy and other political constraints on technology trade would undoubtedly encourage wider and more flexible trading relations over time.

### Perspective 3: Promote Civilian Technology Transfer

Both the technology leverage and decoupling perspectives are oriented more toward technology trade than its transfer. Policymakers may wish to facilitate expanded technology transfers from the United States, and

more extensive absorption of technology by recipients in the Middle East, by establishing more explicit policies. This is based on the assumption that civilian technology transfers have been generally mutually beneficial, and the U.S. Government can do more to promote them. Underlying this perspective is the conviction that it is useless to try to control transfers of civilian technology, and a recognition that U.S. firms can best maintain their technological strength by fully participating in international technology exchange. While retaining national security and nonproliferation controls, this approach would employ other types of export controls only under extraordinary circumstances, such as the Iranian hostage crisis.

A variety of commercial and development assistance policy measures could be used to promote technology transfer. These include expanding assistance programs involving technology transfers in manufacturing and service sectors, upgrading the technical capabilities of the commercial representatives, expanding technical assistance and bilateral investment agreements, improving U.S. Government financing and insurance programs supporting technology transfers, as well as improving the ability of the Federal Government to record and anticipate trends in technical service trade. In light of the interrelationship of manpower problems among countries in the Middle East, U.S. Government-supported technical assistance efforts could include participants from a number of countries, including the higher-income nations. Coordination with private sector firms would be important to the success of all these efforts.

One problem is to coordinate the efforts of Government agencies currently involved in various aspects of these disparate programs. This implies increased allocation of resources, challenges in designing programs aimed to transfer technology, and in evaluating their success. In addition, disagreements might well arise over when "extraordinary circumstances" would justify use of controls on trade. On the other hand, this approach emphasizes the positive aspects of technology



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transfer. While these programs would probably not drastically affect technology trade with close political allies or with strong political opponents, they could open relations with nonaligned countries. This approach is unique in that it could also contribute significantly to regionwide development.

Each of the three policy perspectives outlined above involves a consistent strategy, emphasizing political and economic objectives in different ways. Although each may have its virtues in the abstract, a new consensus on the role of technology transfer in foreign policy would be required to implement fully any one of them.

Even if no consistent technology transfer policy is established, U.S. policy makers will continue to face a fundamental choice as they make decisions on a case-by-case basis: they can promote or discourage technology transfer. Civilian technology transfers to the Islamic countries of the Middle East appear to have been mutually beneficial in economic

terms, and are highly valued by recipient countries. Therefore, U.S. policies—regardless of which goals are maximized—will remain important to Middle Eastern countries.

In the decade ahead, the Middle East will remain a market for U.S. equipment and technical services, and a region of great strategic importance. Instead of subordinating economics to politics, the challenge for U.S. policy-makers is to balance these interests in a more consistent way. In the absence of such effort, the pattern of expanding controls and selective technology trade characteristic of years past is likely to continue. Technology transfers from the United States to countries in the Middle East are a major dimension of U.S. influence there. Despite the negative effects of some technology transfers, more often civilian technology transfers have supported mutually beneficial relations with countries of great strategic and economic importance to the West.